Rock Chips

Fall 2010

Alberta Geological Survey

New Bedrock Topography and Sediment Thickness Maps

Alberta Geological Survey (AGS), as part of its work to produce a digital atlas of Alberta, will release two provincial-scale maps: Map 550 and 551 depict the bedrock topography and thickness of sediment overlying bedrock in Alberta.

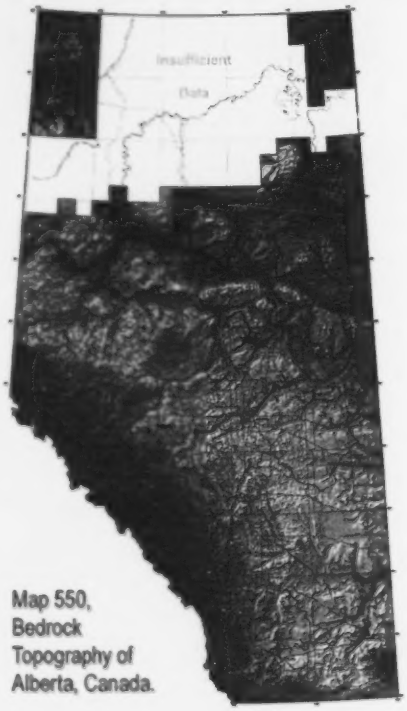
These maps represent computer-generated models using information from existing AGS maps and reports, as well as new stratigraphic data from oil and gas petrophysical logs and water-well litholog records. Consequently, these new maps update earlier reconstructions of the bedrock topography and sediment isopach in Alberta.

Map 550 reveals that the bedrock topography of Alberta is characterized by five major terrain elements: 1. lowlands, 2. plains, 3. uplands, 4. highlands, and 5. paleovalley systems.

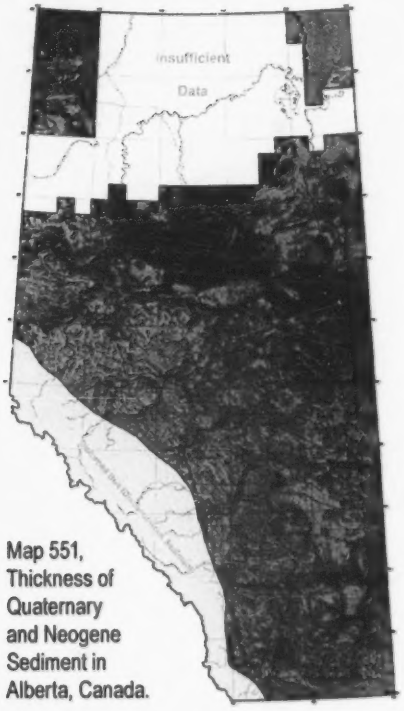
Bedrock lowlands span the northern part of Alberta and are characterized by a low-relief, gently undulating bedrock surface ranging in elevation from 200 to 500 m above sea level (asl).

The plains bedrock terrain element occurs in parts of southern, central and northeastern Alberta and comprises an undulating, gently sloping bedrock surface that rises from 400 m asl in the east to 900 m asl in the west.

Bedrock uplands mainly occur in western and northern Alberta, with small components occurring in the central and southern. This terrain element is characterized by a moderately sloping, dissected surface descending



Map 550, Bedrock Topography of Alberta, Canada.



Map 551, Thickness of Quaternary and Neogene Sediment in Alberta, Canada.

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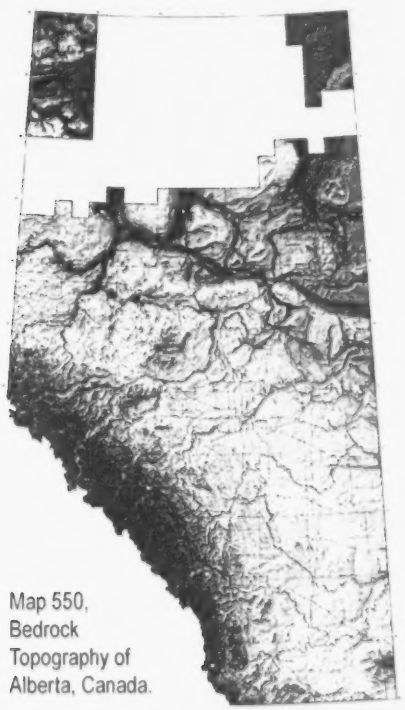

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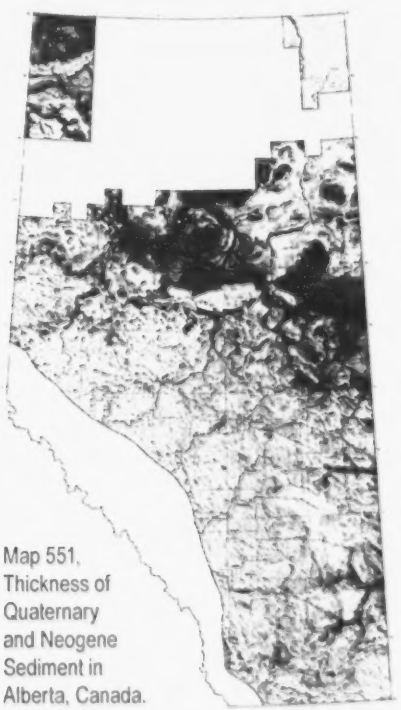

Map 551, Thickness of Quaternary and Neogene Sediment in Alberta, Canada.

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eastward from 1350 to 900 m asl. Throughout Alberta, bedrock uplands also form isolated plateaus, that rise from 500 m asl at their base, to summits that range from 600 to 1400 m asl.

The highlands bedrock terrain element occurs in southwestern Alberta and is defined by steep slopes and variable relief, which reflect the topography of the Rocky Mountains and Foothills.

In general, the distribution of these bedrock terrain elements indicates that the physiography of large areas of the modern Alberta landscape reflect the topography of the underlying bedrock. Exceptions to this relationship occur along regionally integrated paleovalley systems that are incised into the bedrock surface.

The largest of these systems span the width of Alberta between northeastern B.C. and west-central Saskatchewan. Although these paleovalleys form prominent topographic features, some are incised up to 300 m below the adjacent bedrock surface, they have little physiographic expression in the modern landscape because they have been infilled with unconsolidated sediments.

Map 551 depicts the thickness and distribution of these sediments and demonstrates a spatial relationship between sediment thickness and the topography of the underlying bedrock. These sediments include Neogene fluvial deposits, glaciogenic materials deposited during Quaternary glaciation and postglacial deposits.

In general, sediment thickness is greatest in the eastern and northern parts of Alberta, progressively thinning toward the Rocky Mountains. Areas of thicker sediment (greater than 5 m) typically occur across the lowland and plain bedrock terrain elements. Exceptions to this relationship between bedrock topography and sediment thickness occur across some upland terrain elements, where sediment accumulations account for the elevated topography of the modern landscape. However, the areas of thickest sediment (30 to 445 m) occur along the axis of the regionally integrated, bedrock-incised paleovalley systems.

Collectively, these maps will contribute to a better understanding of the Alberta's geological framework. This will provide information to support regulation and public-policy development for water, land use, environmental protection and public safety from natural geological hazards. ❖

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Story Contact Information

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Dr. Mark Fenton Awarded 2010 Provincial Geologists Medal
Mark Fenton (780) 427-1764

Oil Sands Cap Rock Integrity Project
Tony Lemay (780) 422-2619

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Comments and suggestions for Rock Chips may be sent to Maryanne Protz at maryanne.protz@ercb.ca

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The Provincial Geologists Medal is awarded annually by the Committee of Provincial and Territorial Geologists to recognize major contributions in the area of geoscientific research and related developments or applications that serve the mandate of Canada's provincial and territorial geological surveys. This is the first time that this medal has been awarded to a geologist in Alberta.

In 1974, Mark joined the Alberta Geological Survey as a surficial geologist and Quaternary stratigrapher. During the 1970s to 1980s, Mark contributed to the development of the Quaternary stratigraphy in the Cold Lake region, a framework that continues to be important for groundwater and energy development. In the late 1980s, Mark evaluated the effect of glacially deformed bedrock on highwall stability problems in open-pit coal mines. More recently, Mark led a project, funded by the Canada-Alberta Mineral Development Agreement, that detected the first evidence of diamond-bearing kimberlites in Alberta. He also participated in projects funded by the federal government's Targeted Geoscience Initiative and EXTECH programs. Currently, Mark is working on the first provincial compilation map of the complete surficial geology of Alberta.

Mark has a B.Sc. (Hons.) and M.Sc. in geology (University of Manitoba) and a Ph.D. in Quaternary/ Surficial Geology (University of Western Ontario). Contributions to his field of practice have included an adjunct professorship in the Department of Earth and Atmospheric Sciences, University of Alberta, teaching Environmental Geology in the Environmental Resources Management Program (U of A), as well as serving as a councillor for the Geological Association of Canada. Other volunteer activities include creating the Miquelon Lake Provincial Park Geo-Walk and participating in the design of the new Earth History Gallery of the Royal Alberta Museum. ❖

Left to right, Honourable Ron Leipert, Minister of Energy, Alberta, Honourable Serge Simard, Minister of Natural Resources and Wildlife, Quebec, and Mark Fenton receiving his medal.

Left to right, Minister Ron Leipert, Mark Fenton and Corey Froese, Alberta Geological Survey Group Manager.

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In conjunction with the semi-annual meeting of the National Geological Surveys Committee, held in Montreal, QC, on September 19, 2010, a field trip was held for members of all provincial, territorial and federal surveys. Corey Froese and Mark Fenton represented Alberta Geological Survey. The goal of the field trip was to observe and understand the geology along a section of Highway 10 between Montreal and the copper mines in the Estrie-Beauce region, New Sherbrooke.

Mount Royal. The dominant topographic feature of Montreal is a circular hill 232 metres high. The core is made of melanocratic and leucocratic gabbros, diorites, and nepheline monzonites. At the foot are the Trenton Limestone (photo) and the Utica Shale (a current shale gas prospect in Quebec.)

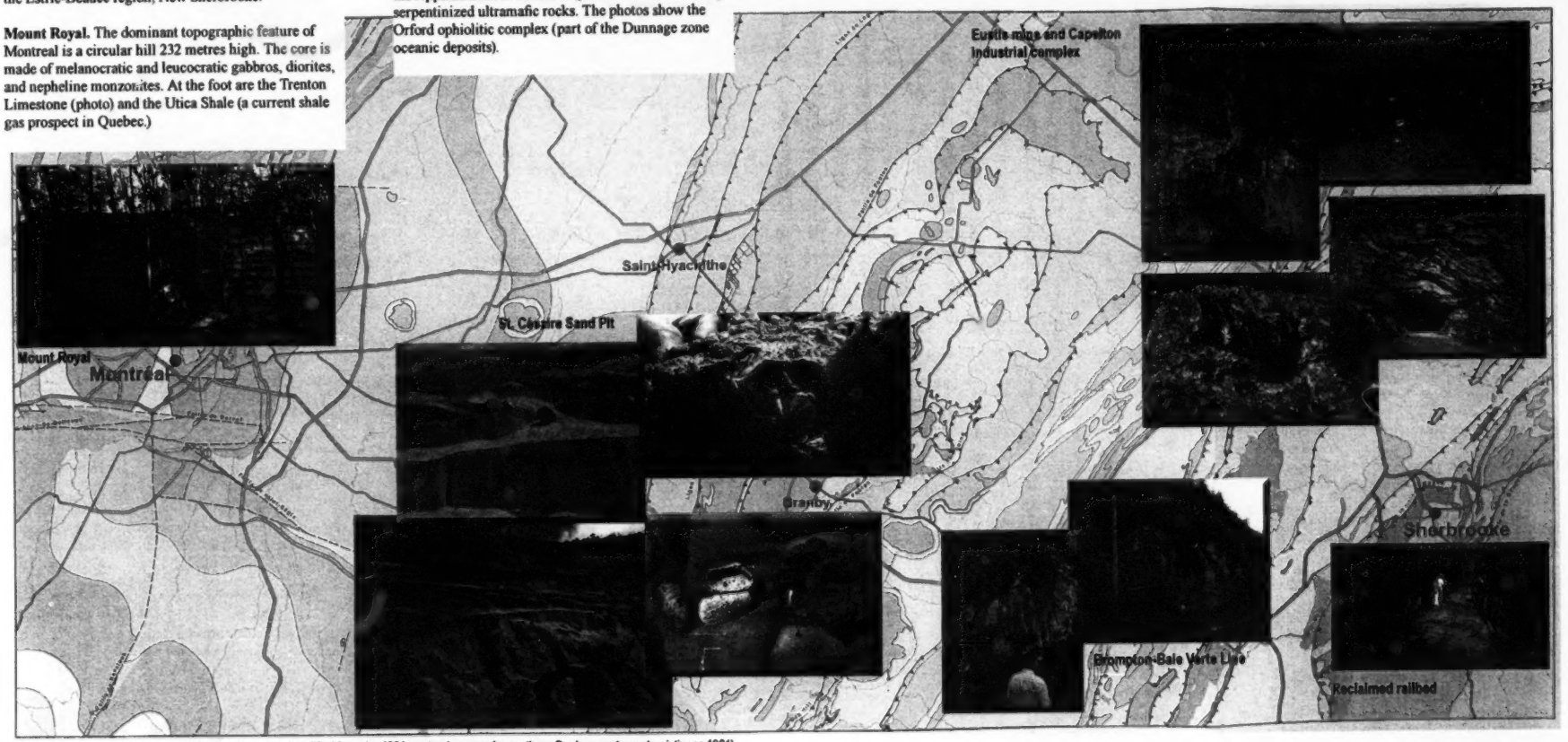
St. Césaire sand pit. This pit has been active for more than 40 years. The pit is predominantly sand and contains glaciofluvial sediment deposited in an esker. The photos show the effects of wind erosion, as well as several fossil types (shells and sponges) recoverable from the exposed Champlain Sea sediments.

Brompton-Baie Verte Line. This is a major suture in the Appalachians of southern Quebec that is marked by serpentinized ultramafic rocks. The photos show the Orford ophiolitic complex (part of the Dunnage zone oceanic deposits).

Reclaimed railbed. Trains on this former railway hauled ore from the Capelton mine to Boston. Now a bike path, it is part of the La Route Verte, connecting much of Quebec and the International Appalachian Trail.

Eustis mine and Capelton industrial complex. The Eustis mine produced copper and pyrite ore from 1865 until 1939. An estimated 3 million tonnes of pyrite and chalcopyrite ore were extracted at a grade of 3% copper and 40% sulphur. The mine survived due to the quality of the deposits and the on-site production of chemical products derived from the extraction of sulphuric acid, nitric acid and gunpowder. The photos show the mine entrance, pyrite oxidization on the mine's exterior, the 1 metre thick ore zone, which was expanded to 2 metres in height for the miners, and coloured seeps of the copper-rich cave deposits. ❖

(Descriptions extracted from the field guide for the trip, written by Andrea Amórtegui, Robert Marquis and Hugo Dubé.)



Geological road map of the Montreal-Sherbrooke region (modified from the 1991 geotourism map for southern Quebec: carte geotouristiques:1991).

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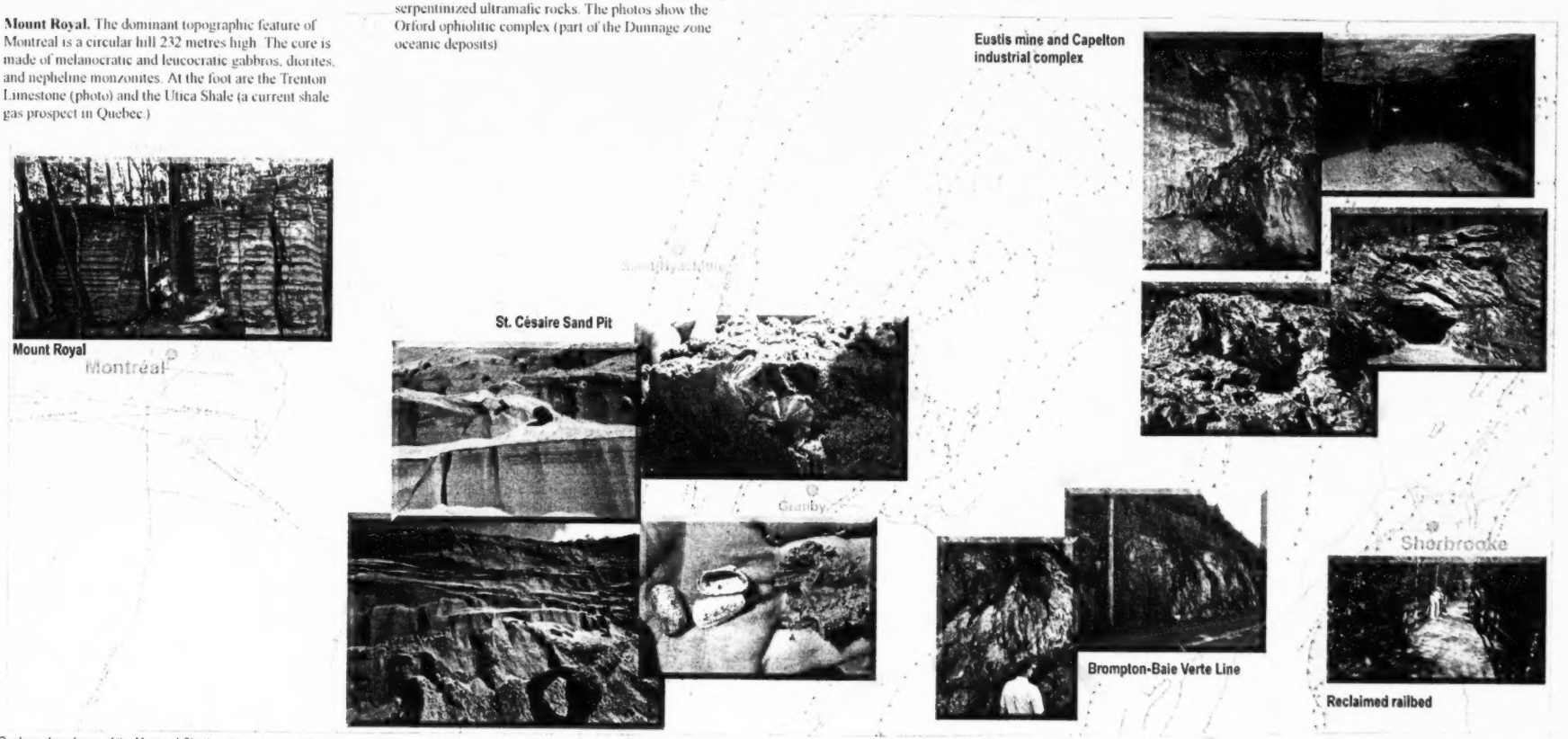

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Oil Sands Cap Rock Integrity Project

One of the duties of the Energy Resources Conservation Board (ERCB) is to regulate in situ oil sands extraction operations. Understanding the extent and properties of the sediments above and below the bitumen resources targeted by in situ operations benefits the ERCB by allowing it to gain a deeper understanding into the geological, geomechanical and hydrogeological conditions present prior to initiation of in situ operations in areas where little or no such development has taken place. The characterization of these sediments will assist the ERCB in its assessments of these types of projects and, therefore, in fulfilling its mission of ensuring that the discovery, development and delivery of Alberta's energy resources takes place in a manner that is fair, responsible and in the public interest.

With these goals in mind, in 2009, two branches within the ERCB began the Oil Sands Cap Rock Integrity Project (OSCRIP).

The Geology, Environmental Science and Economics Branch (of which Alberta Geological Survey is a part) and the Oil Sands Branch began work in a pilot study area (diagram below) to characterize the stratigraphy above and below the bitumen deposits where these resources are proposed to be extracted through in situ means.

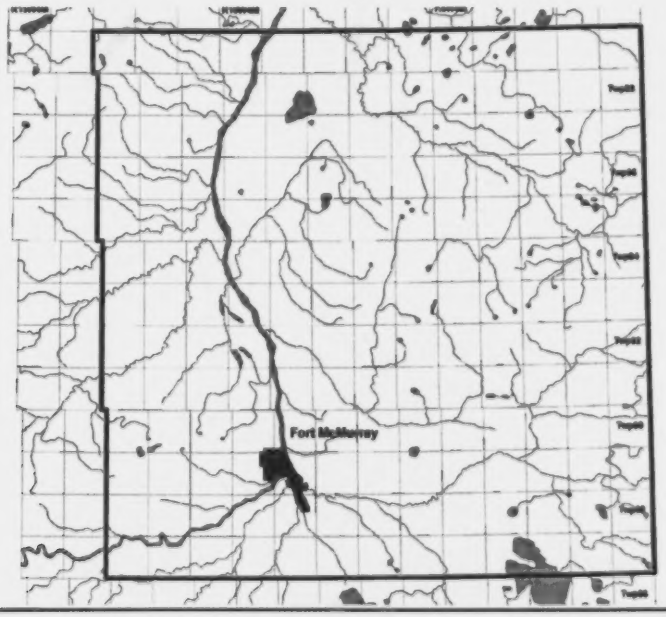
The sedimentary rocks and sediments above the bitumen deposits are being examined because they have variable geological origins and geomechanical properties based on the processes that led to their deposition. These characteristics affect their suitability as capping material for in situ operations.

The strata below the bitumen deposits are being examined because geological factors, such as dissolution of salt, can change the geomechanical properties of overlying units, potentially affecting the capping effectiveness of the material overlying the bitumen resources.

The project area is from Townships 87 to 99 and Ranges 1 to 13W4. The work will have multiple phases. In the first phase, the project team will compile data from existing, internally available information of the study area, including compilation on the extent, geological characteristics and geomechanical properties of the various strata above and below the bitumen deposits. Subsequent phases will supplement these internal datasets with additional information from external sources.

Interpretation of the data will take place throughout the various phases to help guide decisions on what additional data may be required and to arrive at conclusions and recommendations related to the capping properties of overlying sedimentary units and sediments.

The project is scheduled to end in 2012. At that time, the project team will document its findings with maps, reports and databases. ❖



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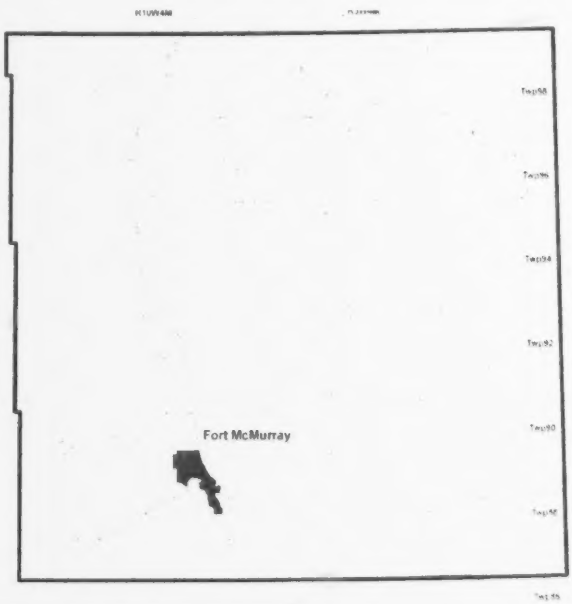

Although it can't be definitively said, it is quite possible that Fran Hein might just literally love rocks. Her passion for geology is obvious to anyone who has worked with her, and her knowledge of the geology of Alberta's oil sands area is encyclopaedic. This passion for geology has taken her, at various times, from Canada's east coast to the west coast of the United States to Canada's northern coast. It has infected the students she has supervised in her many university positions, as well as with the colleagues she has worked.

Fran completed her bachelor's degree in geology at the University of Illinois in Chicago. From there, she moved east and north to complete her master's and doctoral degrees at McMaster University in Hamilton, Ontario. Fran continued her academic career with a number of university positions, including ones at McMaster University, the University of Southern California, Dalhousie University and the universities of Alberta and Calgary. The more than 30 graduate students or post-doctoral students Fran supervised focused on placer gold deposits in the Yukon, or the geology of northern Canada, or modern examples of deep-sea sedimentation.

Fran devotes considerable attention to the development of the geological sciences through professional geological societies. She is an active member of the American Association of Petroleum Geologists (AAPG) and Canadian Heavy Oil Association (CHOA). Fran currently serves as a technical director of the board of directors for the CHOA and as the secretary for the Energy Minerals Division (EMD) of the AAPG. She is past vice-president of the EMD and serves on its Oils (Tar) Sands Committee, and was the co-chair for the 2010 AAPG ICE convention in Calgary. Fran has also contributed her time as an editor for several journals, as well as a reviewer for many others, and is presently co-editing an AAPG memoir on oil sands entitled Heavy Oil/Bitumen Petroleum Systems in Alberta and Beyond.

Fran has worked with the Energy Resources Conservation Board/Alberta Geological Survey for more than 13 years. Much of her work has focused on better understanding the Athabasca Oil Sands deposits and supporting the ERCB in developing regulations to best manage those resources. Recently appointed ERCB's Chief Geologist, she will guide and shape the development of ERCB's geologists, ensure the quality of the scientific material produced by these scientists and contribute to the ongoing understanding of Alberta's geology. ❖

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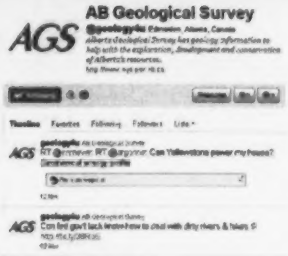

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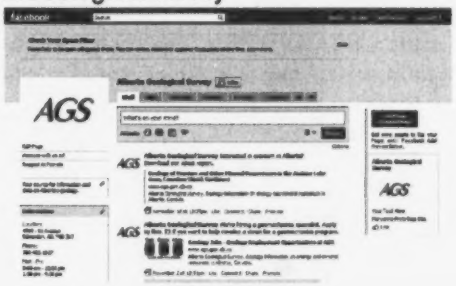

Recent Publications

Open File Reports

OFR 2010-08 Geology of Uranium and Other Mineral Occurrences in the Andrew Lake Area, Canadian Shield, Northeastern Alberta (NTS 74M/16).

OFR 2010-11 Surficial Geology and Quaternary History of the Cleardale Area, Northwestern Alberta (NTS 84D/SW).

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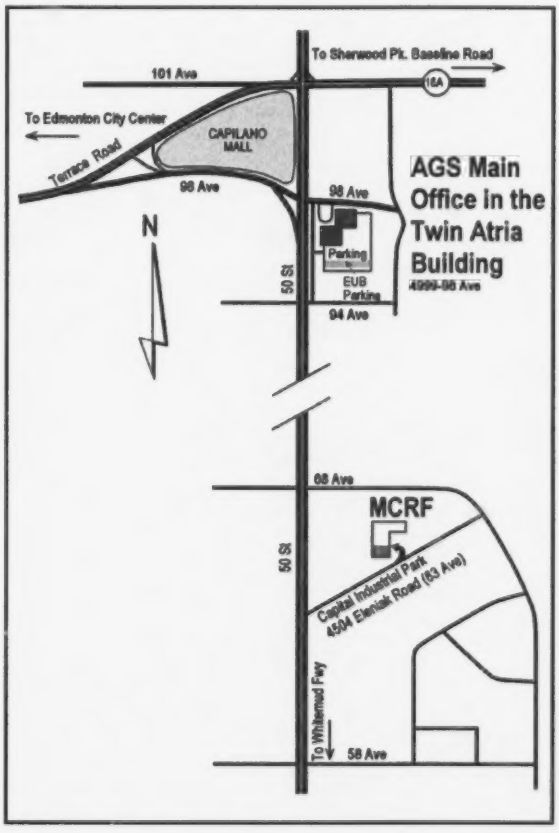

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The Career of Dr. Fran Hein

Although it can't be definitively said, it is quite possible that Fran Hein might just literally love rocks. Her passion for geology is obvious to anyone who has worked with her, and her knowledge of the geology of Alberta's oil sands area is encyclopaedic. This passion for geology has taken her, at various times, from Canada's east coast to the west coast of the United States to Canada's northern coast. It has infected the students she has supervised in her many university positions, as well as with the colleagues she has worked.

Fran completed her bachelor's degree in geology at the University of Illinois in Chicago. From there, she moved east and north to complete her master's and doctoral degrees at McMaster University in Hamilton, Ontario. Fran continued her academic career with a number of university positions, including ones at McMaster University, the University of Southern California, Dalhousie University and the universities of Alberta and Calgary. The more than 30 graduate students or post-doctoral students Fran supervised focused on placer gold deposits in the Yukon, or the geology of northern Canada, or modern examples of deep-sea sedimentation.

Fran devotes considerable attention to the development of the geological sciences through professional geological societies. She is an active member of the American Association of Petroleum Geologists (AAPG) and Canadian Heavy Oil Association (CHOA). Fran currently serves as a technical director of the board of directors for the CHOA and as the secretary for the Energy Minerals Division (EMD) of the AAPG. She is past vice-president of the EMD and serves on its Oils (Tar) Sands Committee, and was the co-chair for the 2010 AAPG ICE convention in Calgary. Fran has also contributed her time as an editor for several journals, as well as a reviewer for many others, and is presently co-editing an AAPG memoir on oil sands entitled Heavy Oil/Bitumen Petroleum Systems in Alberta and Beyond.

Fran has worked with the Energy Resources Conservation Board/Alberta Geological Survey for more than 13 years. Much of her work has focused on better understanding the Athabasca Oil Sands deposits and supporting the ERCB in developing regulations to best manage those resources. Recently appointed ERCB's Chief Geologist, she will guide and shape the development of ERCB's geologists, ensure the quality of the scientific material produced by these scientists and contribute to the ongoing understanding of Alberta's geology. ❖

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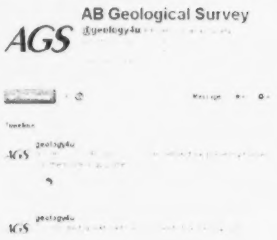

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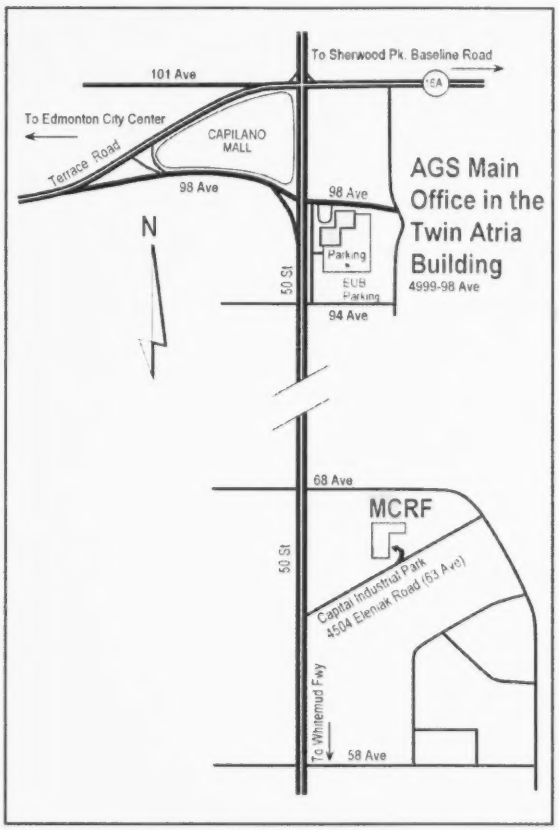

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